

REMARKS

This Amendment is submitted in response to the outstanding Office Action, dated October 24, 2003. The present application was filed on December 23, 1999 with claims 1 through 59. Claims 39-46 were cancelled in the Response to Office Action dated May 29, 2003, in response to an election requirement. Claims 1-38 and 47-59 are presently pending in the above-identified patent application. Claims 1, 2, 4, 6-10, 13, 15, 18, 20, 24, 31-35, 38, and 47-59 are proposed to be amended herein.

In the Office Action, the Examiner maintained a rejection of claims 1, 3, 5-12, 18, 21, 22, and 47-49 under 35 U.S.C. § 102(e) as being anticipated by Zhong et al. (United States Patent Number 5,970,104) and maintained a rejection of claims 24, 31-38, and 56-59 under 35 U.S.C. § 103(a) as being unpatentable over Zhong et al. The Examiner also indicated that claims 13-17 and 50-55 are allowed and indicated that claims 2, 4, 19, 20, 23 and 25 would be allowable if rewritten in independent form including all of the limitations of the base claims and any intervening claims.

Claims 2 and 4 have been amended to change a period following the equation to a comma.

Independent Claims 1, 13, 18, 24, 38, 47, 50, 53, 56 and 59

Independent claims 1, 18, and 47 under 35 U.S.C. § 102(e) as being anticipated by Zhong et al. and rejected claims 24, 38, 56, and 59 under 35 U.S.C. § 103(a) as being unpatentable over Zhong et al.

Regarding claims 1 and 47, for example, the Examiner asserts that Zhong teaches steps/means for pre-computing branch metrics, referring to FIG. 1 and column 2, line 22, to col. 3, line 20. In the Response to Arguments section of the present Office Action, the Examiner asserts that Zhong discloses steps/means 120 for precomputing branch metrics that precomputes and stores possible combinations of branch metrics. The Examiner states on page 6 (last two lines) that claims 1, 18, 24, 38, 47, 56, and 59 do not have other limitations to make the claimed step of precomputing branch metrics distinguishable from Zhong's patent. Thus, Applicants have amended the independent claims to emphasize that the branch metrics of the present invention are precomputed for speculative sequences of channel symbols. The term "reduced complexity sequence estimation" has also been removed from the claims to avoid any ambiguity. Applicant submits that the additional detail included in each independent claim regarding the precomputation of branch metrics

distinguishes the present invention from all cited references.

First, Applicants maintain that Zhong does not disclose or suggest the *precomputation* of branch metrics. Rather, Zhong discloses a method to generate a branch metric table, but does not disclose the precomputation of this table ahead of time (e.g., it is not disclosed to precompute branch metrics for transitions from time step  $n$  to  $n+1$  already at time  $n-1$  or earlier, and it is also not disclosed to precompute branch metrics for combined transitions from time step  $n$  to time  $n+2$  already at time  $n-2$  (see col. 4, lines 13-28 and Fig. 2 in Zhong). In other words, while the Branch Metric Table may generate an output based on the current parallel data signals, it does *not* attempt to pre-compute branch metrics for future ACS decisions.

In any event, Zhong does not disclose or suggest precomputing branch metrics for *speculative sequences of channel symbols*, as required by each independent claim, as amended. As discussed in column 4, Zhong generates branch metrics in convolutional code Viterbi decoders. Zhong does not deal with detectors for channels with intersymbol interference (ISI), where branch metrics depend on previously transmitted channel symbols. Zhong only discloses a convolutional code Viterbi decoder where the signals are not impaired by ISI, but just noise. In this case, branch metrics are computed based on the *current* received signal, and branch metrics do not depend on previously transmitted channel symbol sequences. For example, in Zhong, col. 4, lines 29-49, branch metrics are computed for time  $n$  by the combinations of the current received signals  $I1$  and  $Q1$ , and likewise branch metrics are computed for time  $n+1$  by the combinations of the current received signals  $I2$  and  $Q2$ .  $I1$  and  $Q1$  (and likewise for  $I2$  and  $Q2$ ) are the inphase and quadrature component of a complex valued signal. In the current application, however, branch metrics are *precomputed* for future ACS decisions using *speculative sequences* of previously transmitted channel symbols.

With regard to claim 1 (and other corresponding independent claims), it is noted that branch metrics are selected based on decisions from corresponding states, as set forth, for example, in the second step of claim 1. This decision can be a survivor symbol or an add-compare-select (ACS) decision from a corresponding state (see, e.g., claims 11 and 12). In Zhong, it is mentioned that the ACS circuit 114 generates a state signal 121 which is applied to the branch index generator (col. 3, lines 8-10). However, Zhong does not disclose that the states signal 121 is a decision, and that decisions from corresponding states are used to select the branch metrics, as required by each independent claim.

With regard to claim 18, it is noted that the signals  $I1+Q1$  in Zhong are not two-dimensional branch metrics, but one-dimensional branch metrics for complex valued signals, as would be apparent to a person of ordinary skill. The combination  $I1+Q1+I2+Q2$  are not two-dimensional branch metrics, but accumulated one-dimensional branch metrics for time step  $n$  and  $n+1$ . With the present invention, on the other hand, two-dimensional branch metrics are computed for a multidimensional trellis code by combining one-dimensional branch metrics for the same time step.

With regard to claims 24, 38, 56, and 59, it is noted that a prefilter is used to shorten the channel memory, which reduces the maximum number of precomputed branch metrics. Branch metrics are then precomputed for speculative channel symbol sequences for this shortened channel memory. Thus, the prefilter affects the step of precomputing branch metrics, as it shortens the channel memory and therefore the length of the speculative channel symbol sequences.

Thus, Zhong et al. do not disclose or suggest *pre*-computing a branch metric for *speculative* sequences of one or more channel symbols, as required by each independent claim 1, 13, 18, 24, 38, 47, 50, 53, 56 and 59, as amended.

Dependent Claims 2-12, 14-17, 19-23, 25-37, 48-49, 51-52, 54-55, and 57-58

Dependent claims 3, 5-12, 21, 22, and 48-49 under 35 U.S.C. § 102(e) as being anticipated by Zhong et al. and rejected claims 31-37, and 57-58 under 35 U.S.C. §103(a) as being unpatentable over Zhong et al.

Claims 2-12, 14-17, 19-23, 25-37, 48-49, 51-52, 54-55, and 57-58 are dependent on claims 1, 13, 18, 24, 47, 50, 53, and 56, respectively, and are therefore patentably distinguished over Zhong et al. because of their dependency from amended independent claims 1, 13, 18, 24, 47, 50, 53, and 56 for the reasons set forth above, as well as other elements these claims add in combination to their base claim. In particular, Zhong does not disclose how the state signal 121 is generated. It is clear from the specification and the figures in Zhong, however, that this state signal is not a survivor symbol (i.e., there is no signal path from the path memory to the branch index generator 112 (see Figure 1)). Claim 11 requires that survivor symbols are used to select the branch metrics. Zhong also does not disclose that branch metrics are selected based on ACS decisions. As it is known in the art, the ACS decision is the output  $d0,n+1$  of the compare block 504 in Figure 5 of Zhong, and this decision is not used in the branch index generator 112. Claim 12 requires that branch metrics are selected based on corresponding ACS decisions.

The Examiner already indicated that claims 51-52 and 54-55 are allowed and indicated that claims 2, 4, 19, 20, 23 and 25 would be allowable if rewritten in independent form including all of the limitations of the base claims and any intervening claims.

Conclusion

5 All of the pending claims, i.e., claims 1-38 and 47-59, are in condition for allowance and such favorable action is earnestly solicited.

If any outstanding issues remain, or if the Examiner has any further suggestions for expediting allowance of this application, the Examiner is invited to contact the undersigned at the telephone number indicated below.

10 The Examiner's attention to this matter is appreciated.

Respectfully submitted,



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